Applying the National Water Model in Texas

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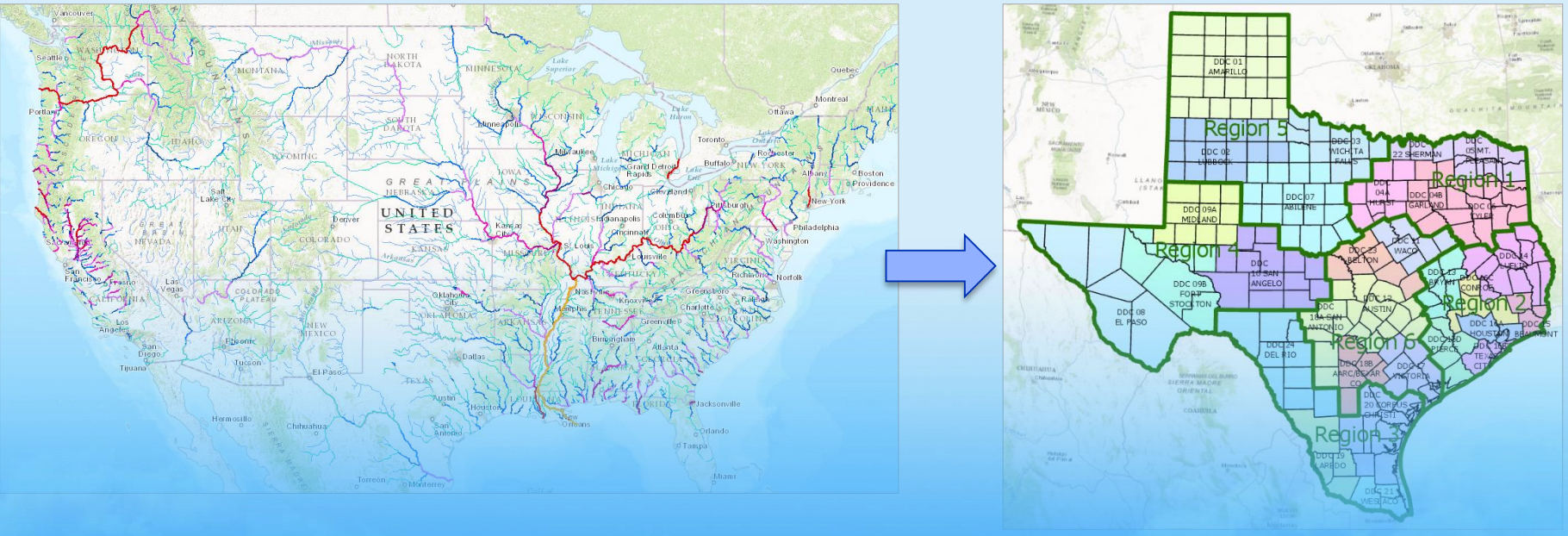


Presentation for TWDB Water for Texas Conference, Austin,Texas, 22 January 2017

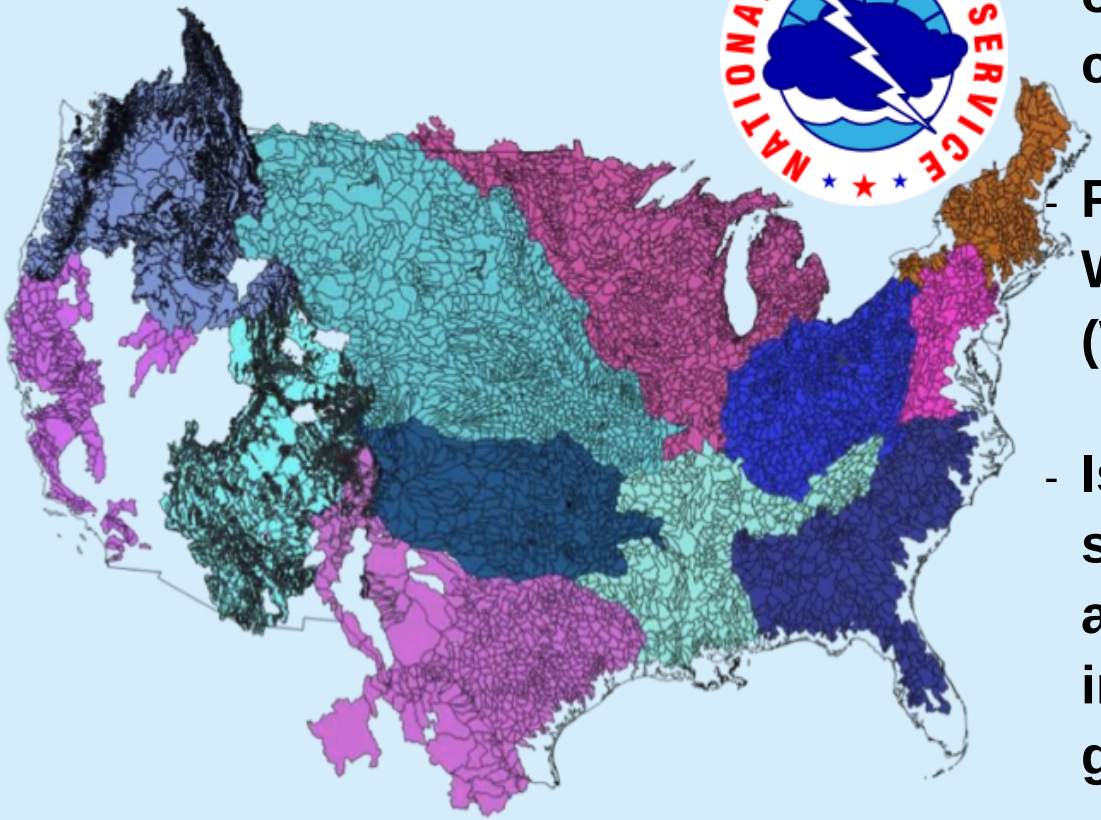
Acknowledgments: Ed Clark, National Weather Service; Yan Liu, University of Illinois; David Tarboton, Utah State University; David Arctur, Harry Evans, Xing Zheng, University of Texas at Austin; City of Austin, National Weather Service, NCAR, CSEC, Texas Division of Emergency Management, ESRI, Kisters, National Science Foundation, colleagues and students at UT Austin

The Opportunity

New National Water Center established on the Tuscaloosa campus of University of Alabama by the National Weather Service and federal agency partners

Has a mission to assess hydrology in a new way at the continental scale for the United States

NWS River Forecast Centers (RFCs)



6600 sub-basins in continental US

- **Prepare river and flood forecasts using models based on average basin characteristics**
- **Provide forecast guidance to Weather Forecast Offices (WFOs)**
- **Issue daily stage and streamflow forecasts, rainfall and drought data and information, and flash flood guidance**
- **Work with water managers and other Federal Agencies**

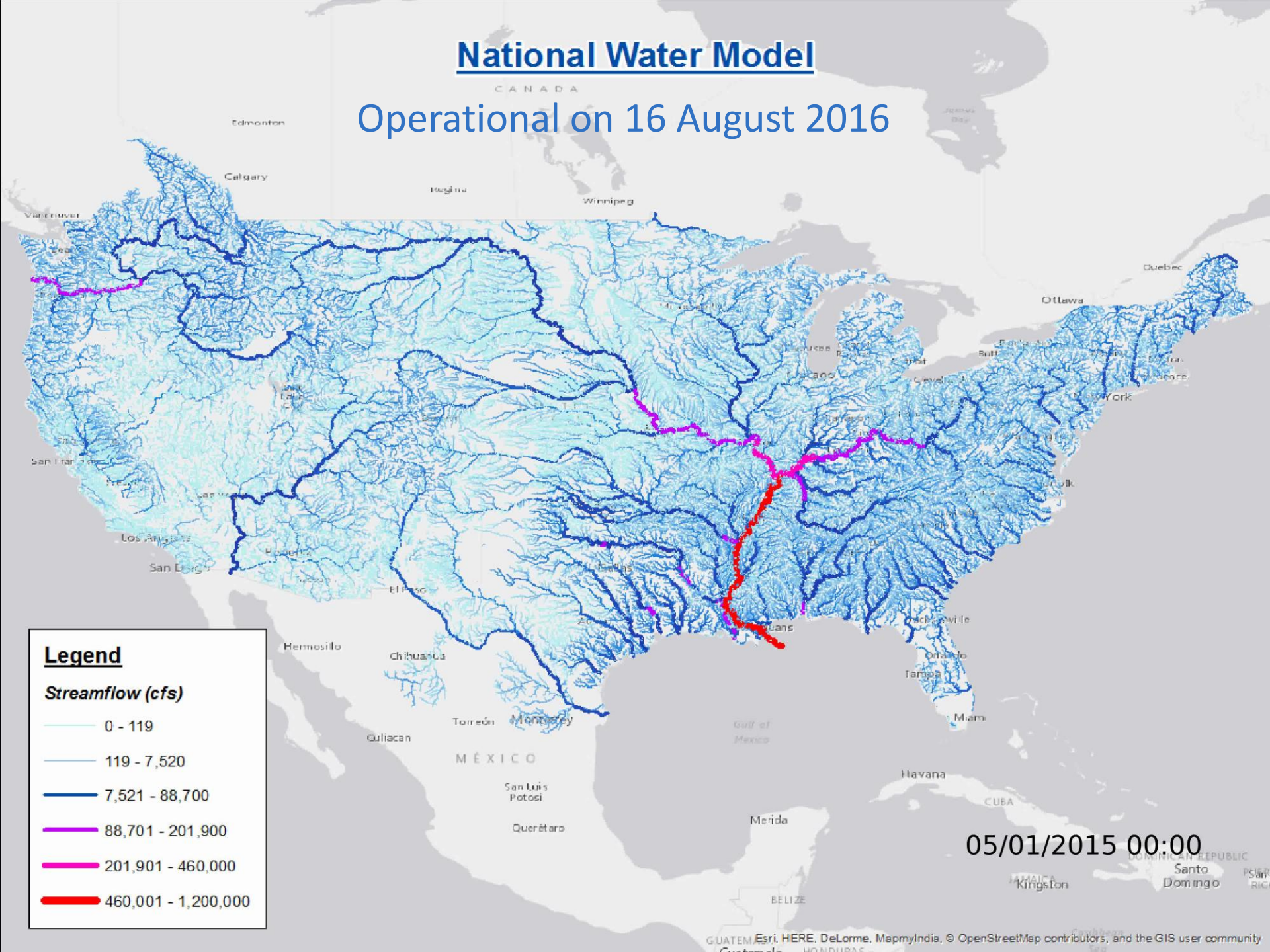
Centralized Water Forecasting

This meeting led to an engagement between the academic community of the United States and the National Weather Service to help build the National Water Model

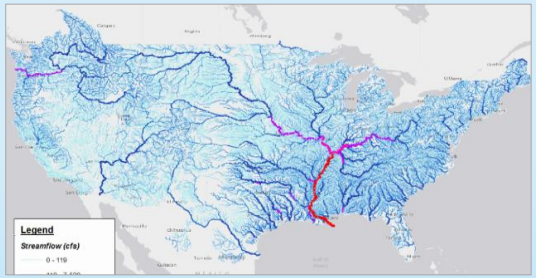
Inaugural Meeting – May, 2014

National Water Model

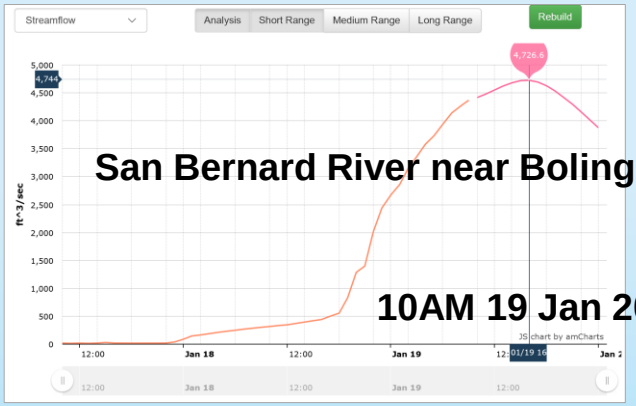
Operational on 16 August 2016



Forecasts from National Water Model



2.7 million stream reaches



San Bernard River near Boling, Tex

10AM 19 Jan 2017

Now

Analysis — **Best estimate of current conditions**

Short Range — **Hourly for 15 hours ahead**

Medium Range — **3 Hourly for 10 days ahead**

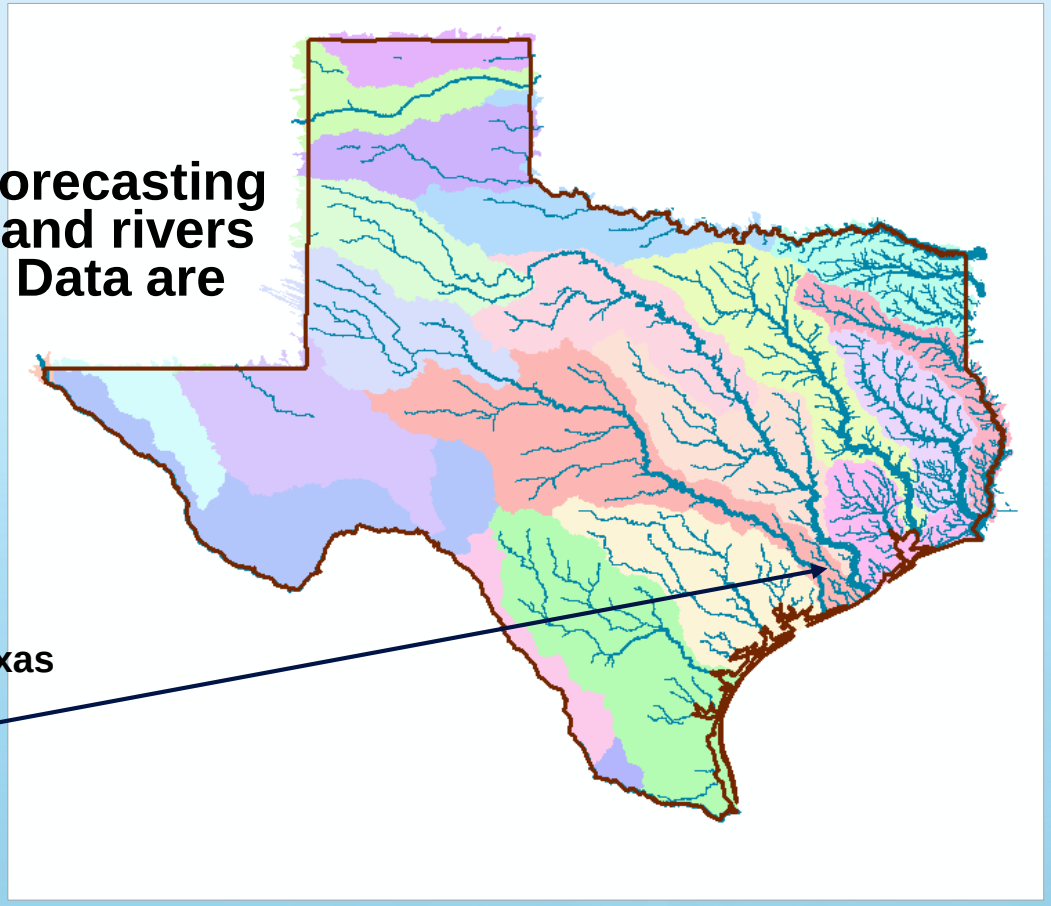
Long Range — **Daily for 30 days ahead**

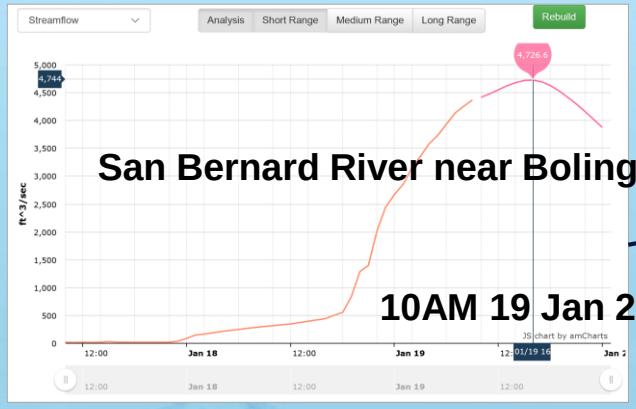
Ensemble of 4 forecasts each 6 hours (16 forecasts total)

(5 TB of forecast information per day)

NOAA National Water Model in Texas

Continuous real-time water forecasting on 190,000 miles of streams and rivers divided into 98,000 reaches. Data are publicly accessible now





San Bernard River near Boling, Texas

10AM 19 Jan 2017

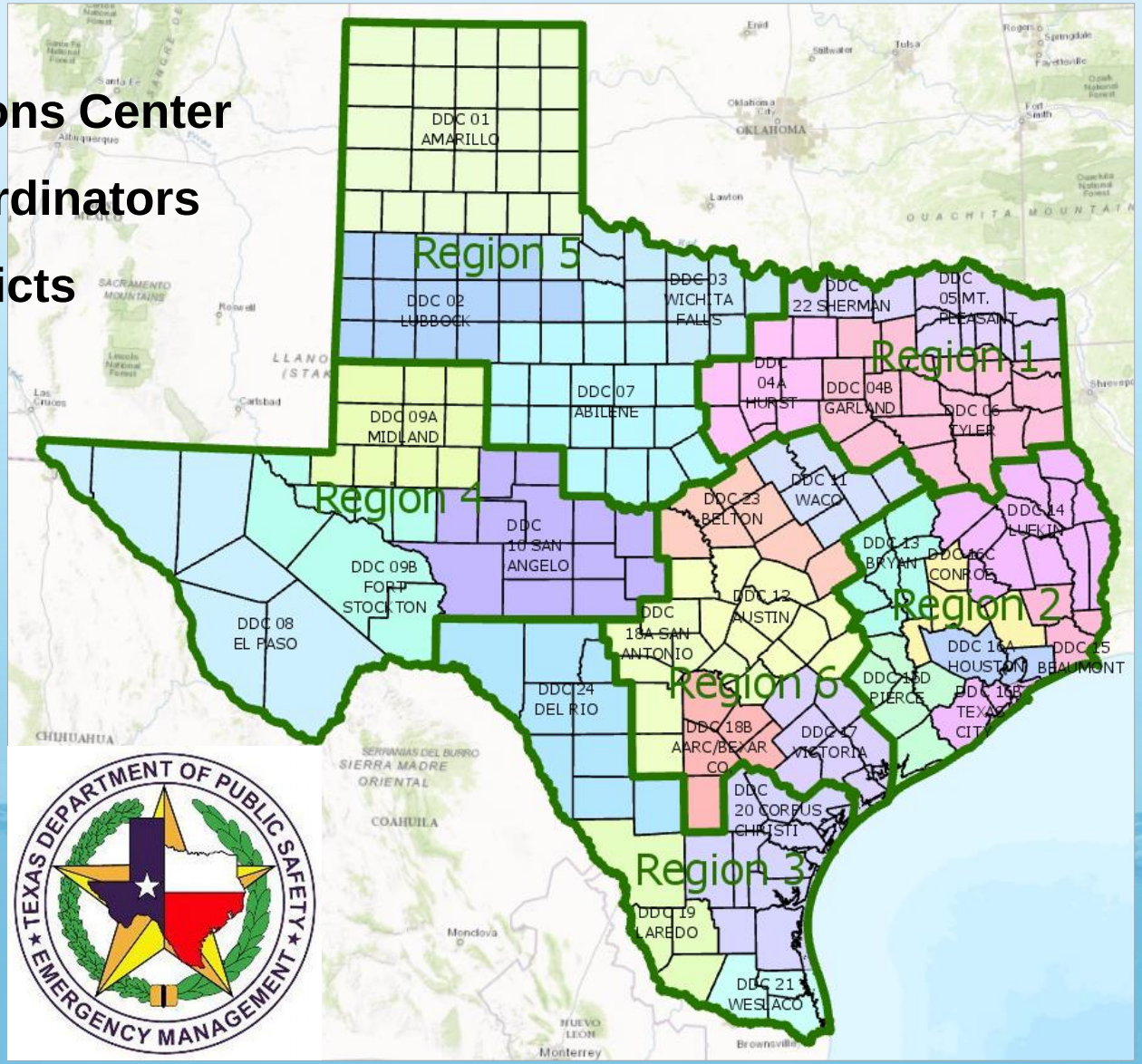
Short Range Analysis

A transformative improvement for flood resilience in our state!

Texas Division of Emergency Management

- State Operations Center
- Regional Coordinators
- Disaster Districts
- Counties

Chief Nim Kidd
Director, TDEM

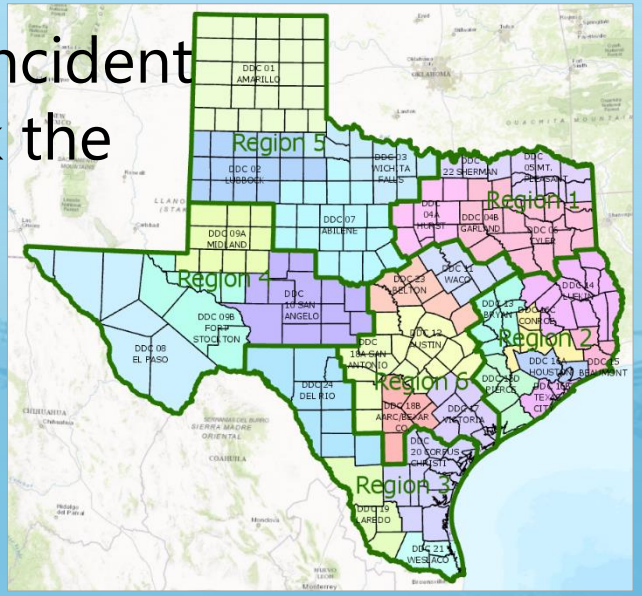


Flood Emergency Response in Texas

Local governments (counties, cities, or towns) respond to *emergencies* daily using their own resources

They rely on mutual aid and assistance agreements with neighboring jurisdictions

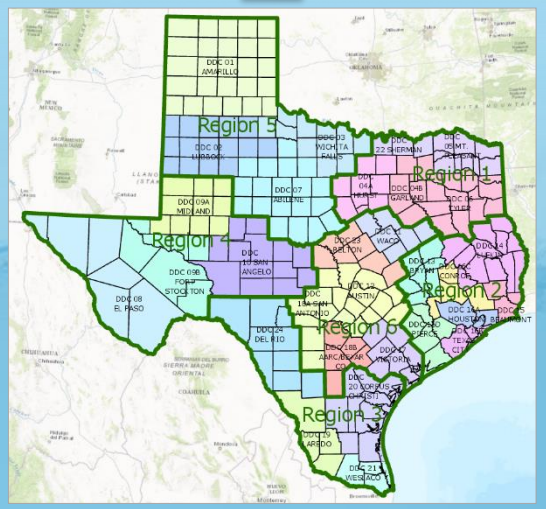
When local jurisdictions cannot meet incident response resource needs, they may ask the state for assistance



Information Flow During a Flood Emergency

Weather and Flood Forecasting

Flood Impacts

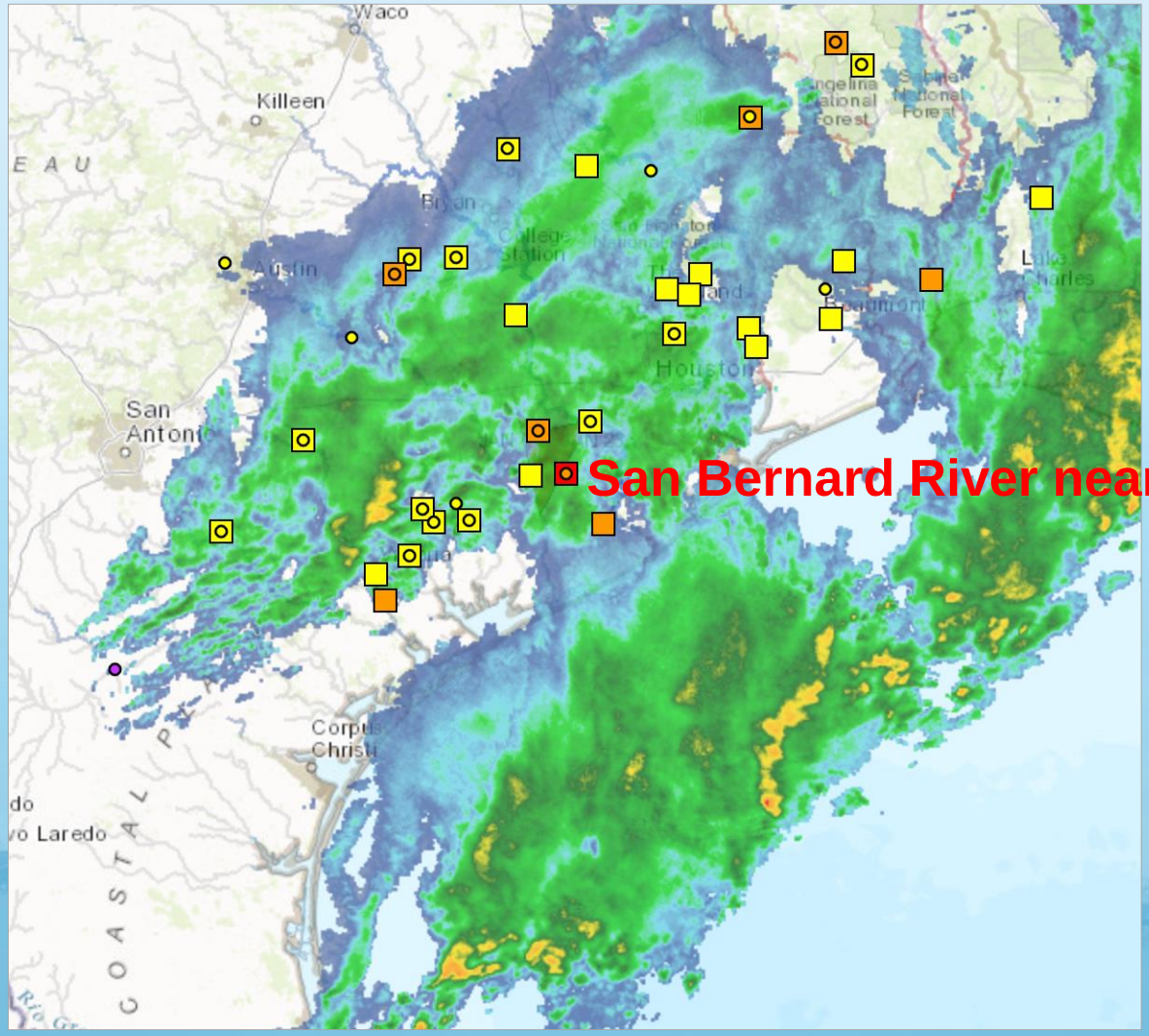


Assessment of Conditions

Communications cycle

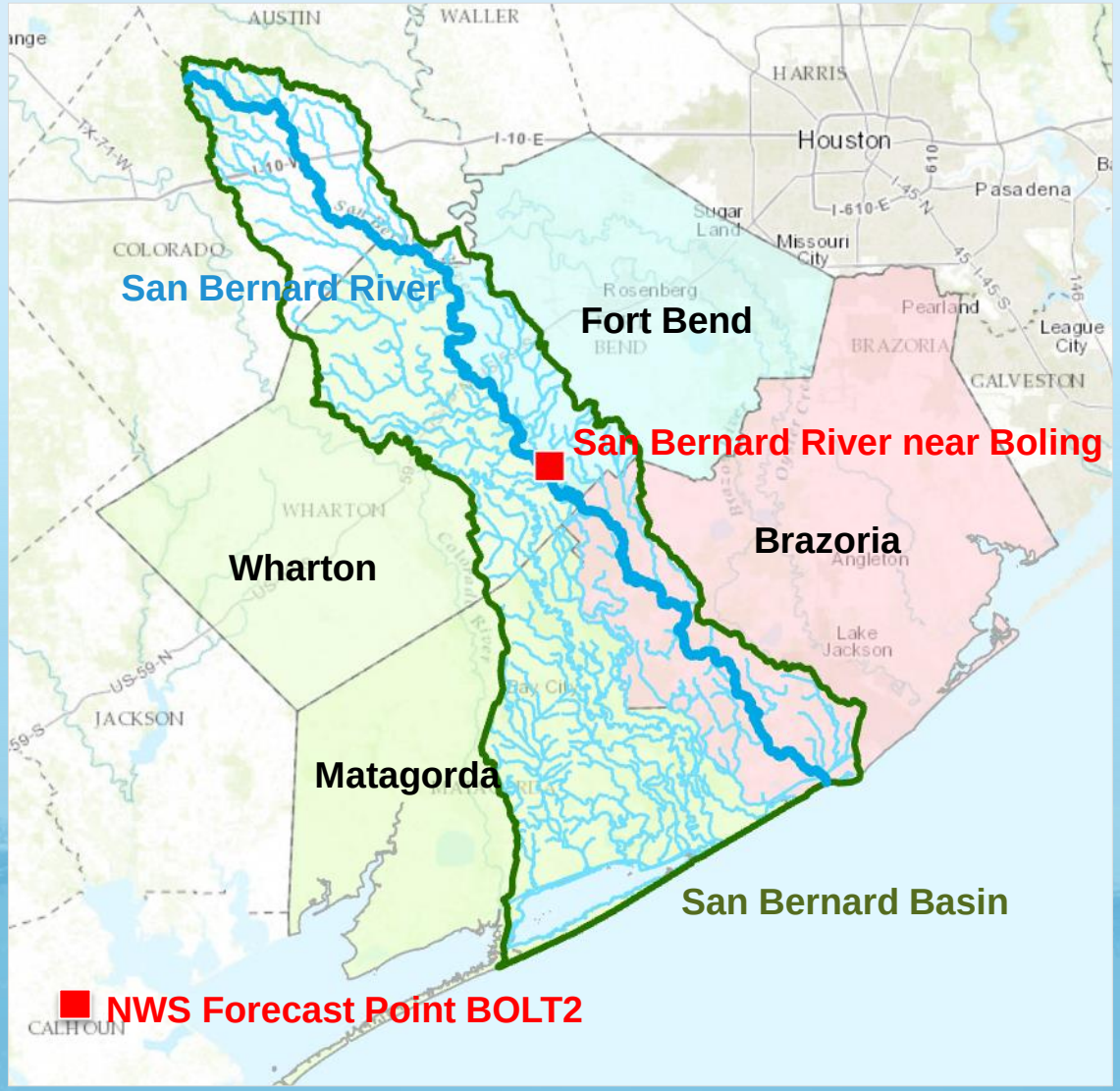
Emergency Response

Storm in San Bernard Basin, 18 Jan 2017

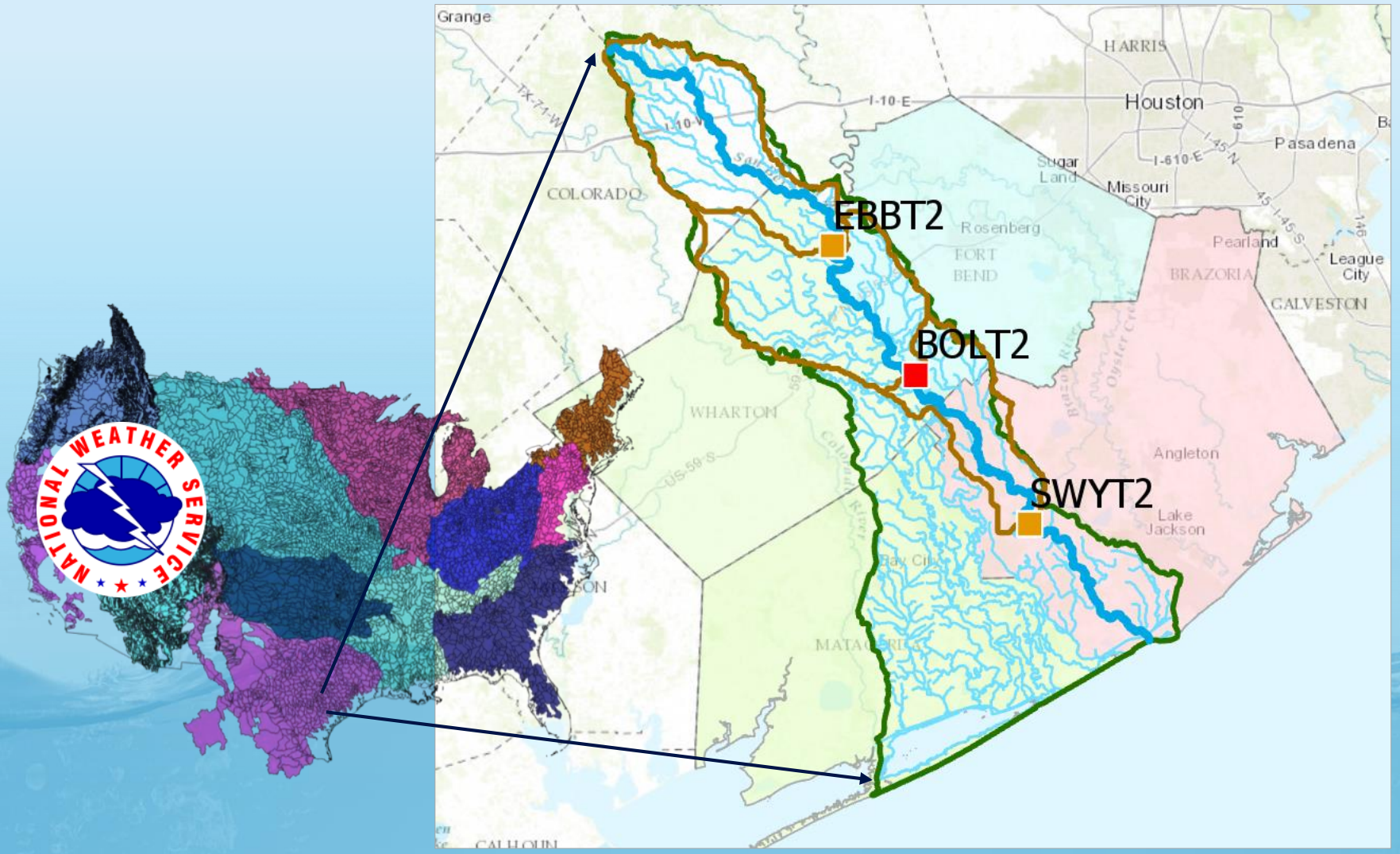


http://gisdev.srh.noaa.gov/rfcdss2.html

Area of Concern: San Bernard Basin in Brazoria, Fort Bend, Wharton and Matagorda Counties in Texas

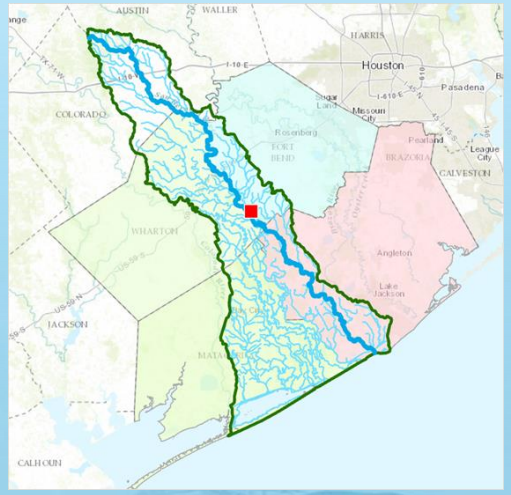


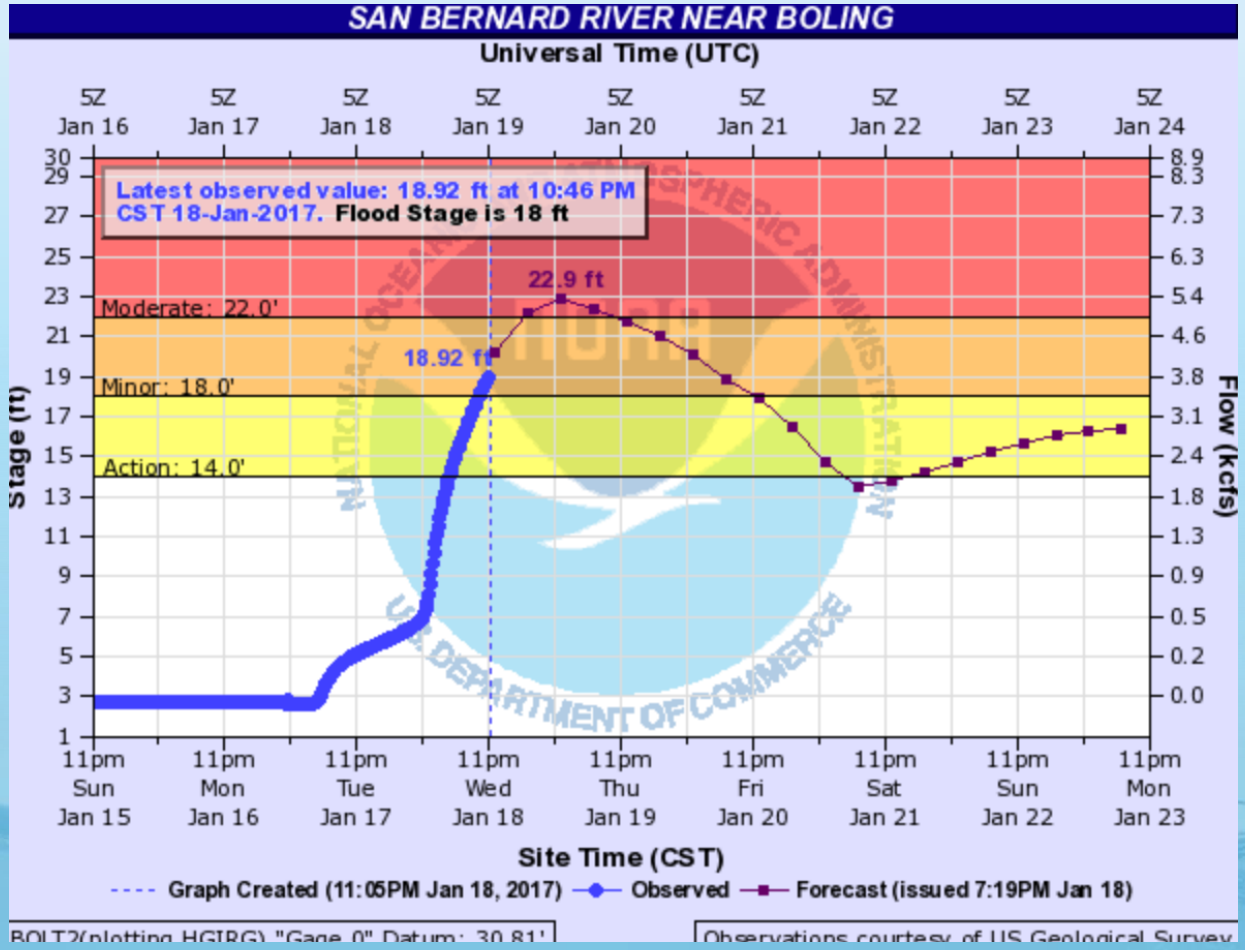
NWS Forecast Points and Basins in San Bernard Basin



West Gulf River Forecast Center Largest Impact: Forecast of Moderate Flooding (at BOLT2)

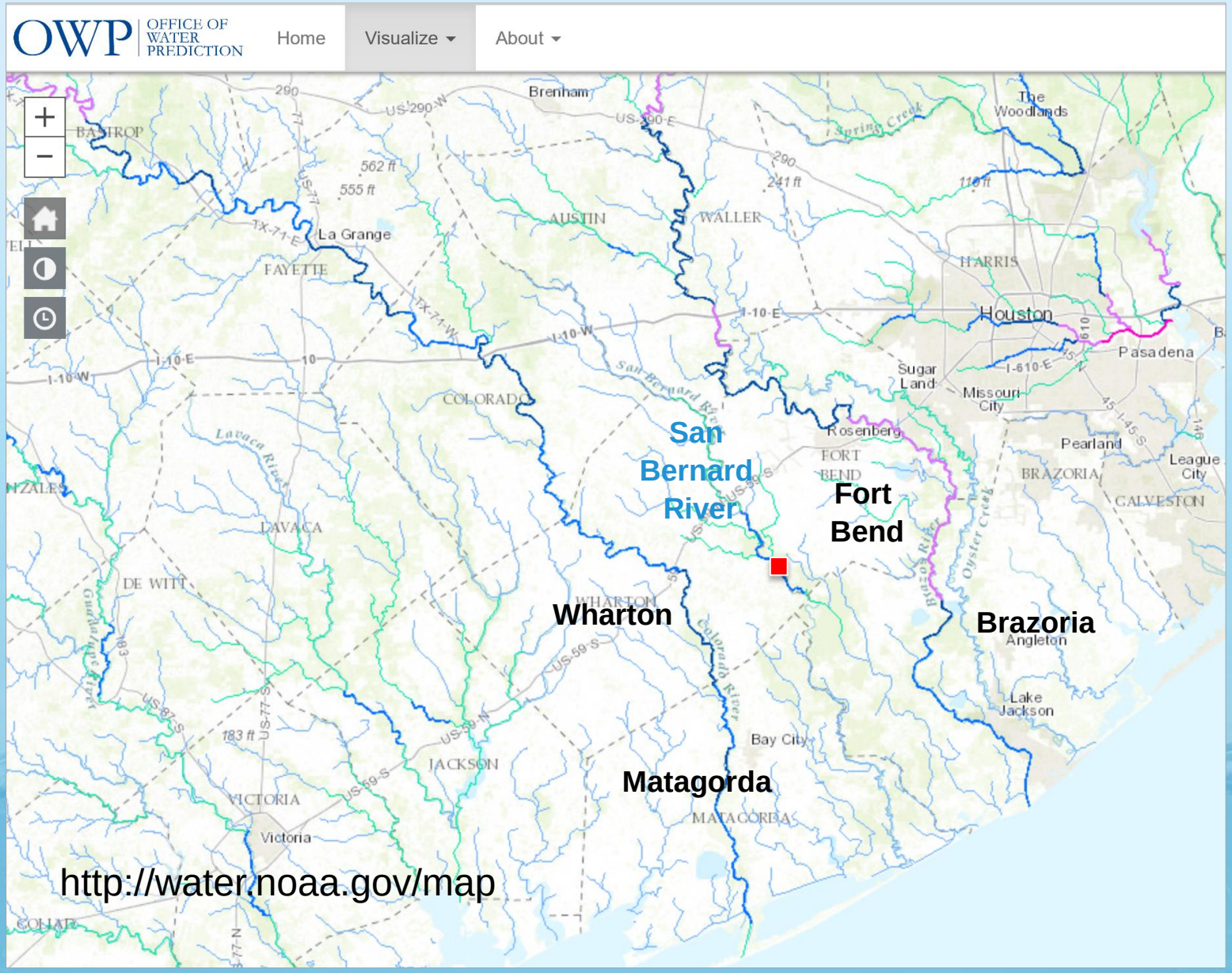
(made at 7:19PM 18 Jan 2017)





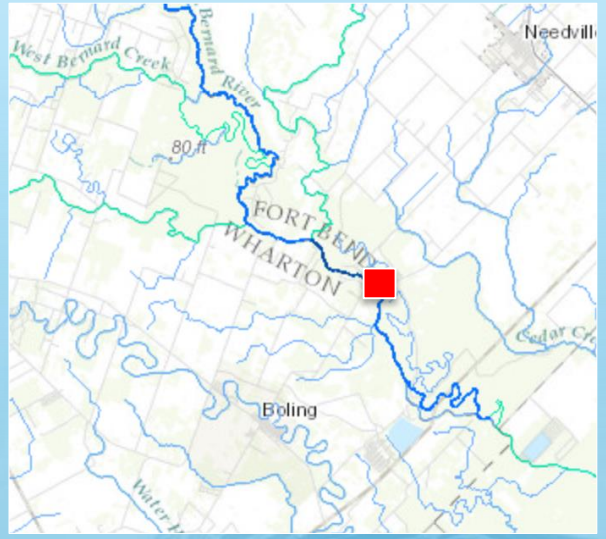
http://water.weather.gov/ahps2/hydrograph.php?wfo=hgx&gage=bolt2

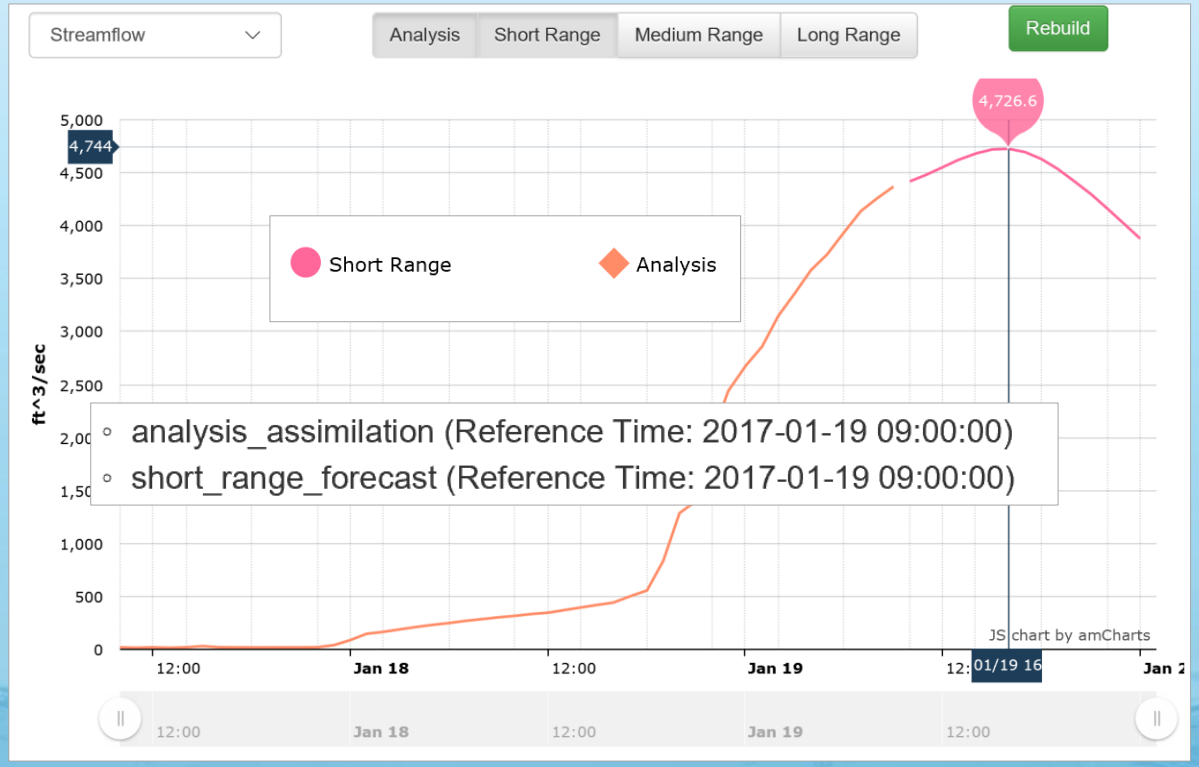
National Water Model Forecast Map



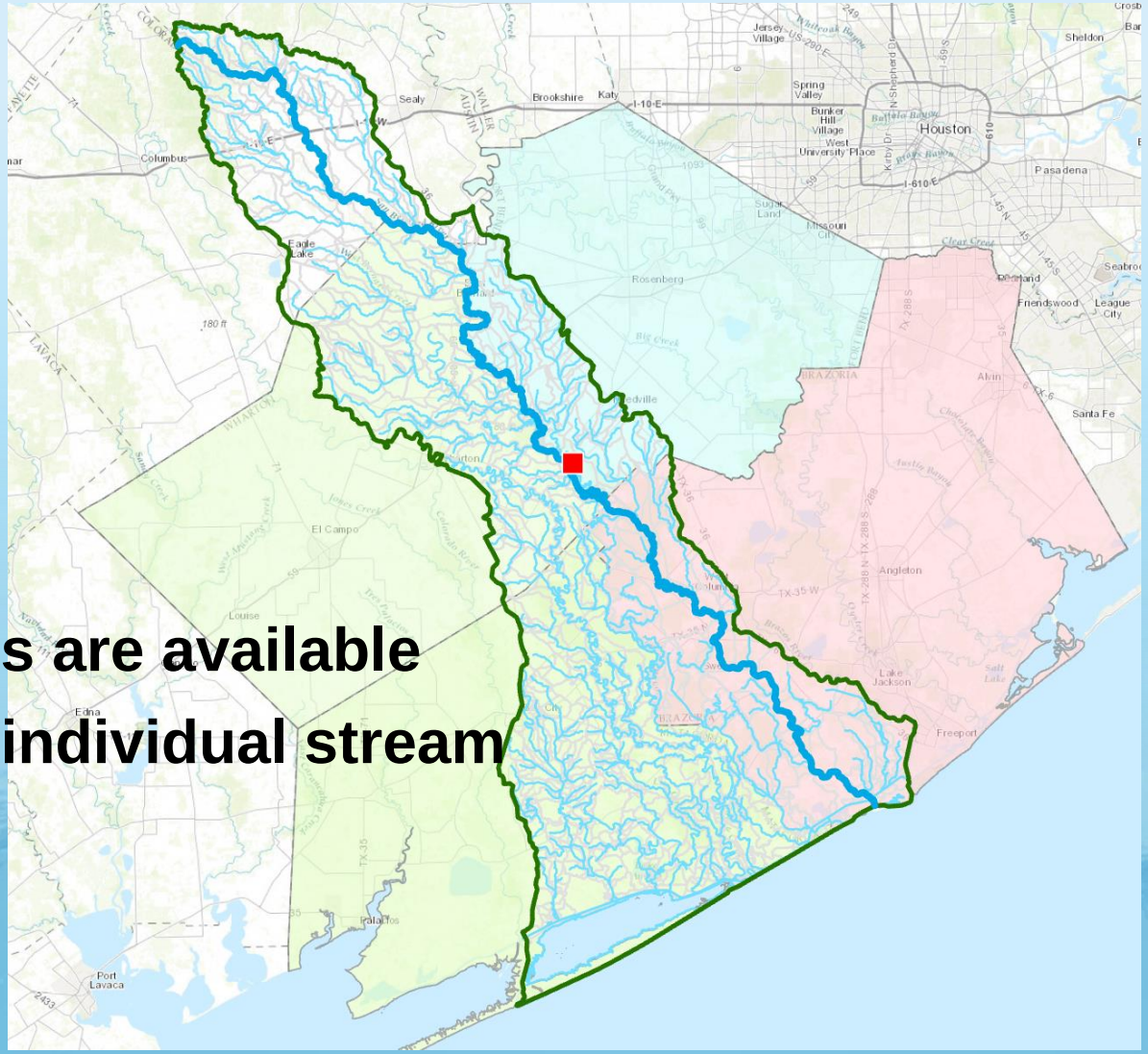
Forecast of National Water Model for San Bernard River at Boling (peak of 4727 cfs at 10AM)

(made at 3 AM Central Time, accessed at 5:30AM 18 Jan 2017)





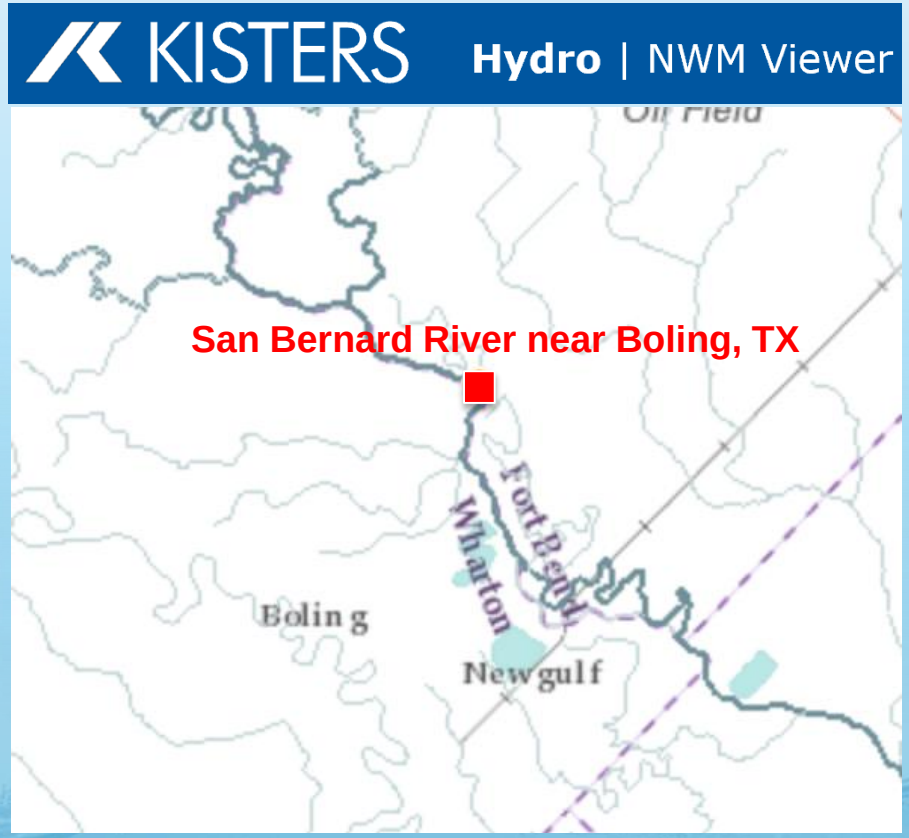
National Water Model in San Bernard Basin (800 catchments and stream reaches)

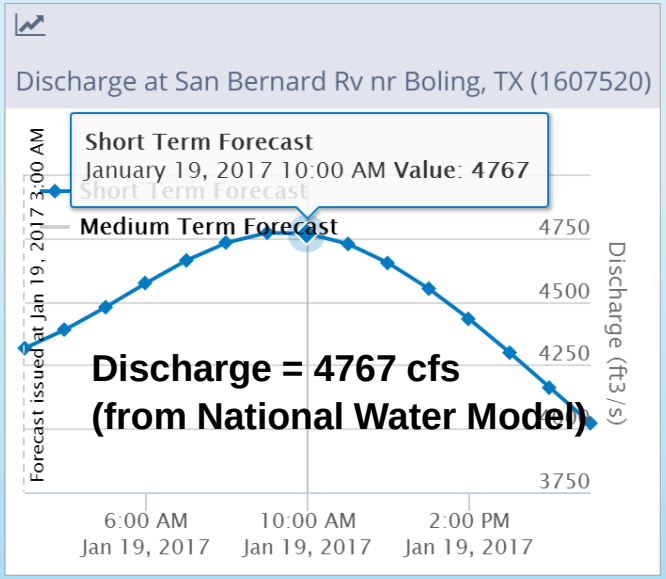


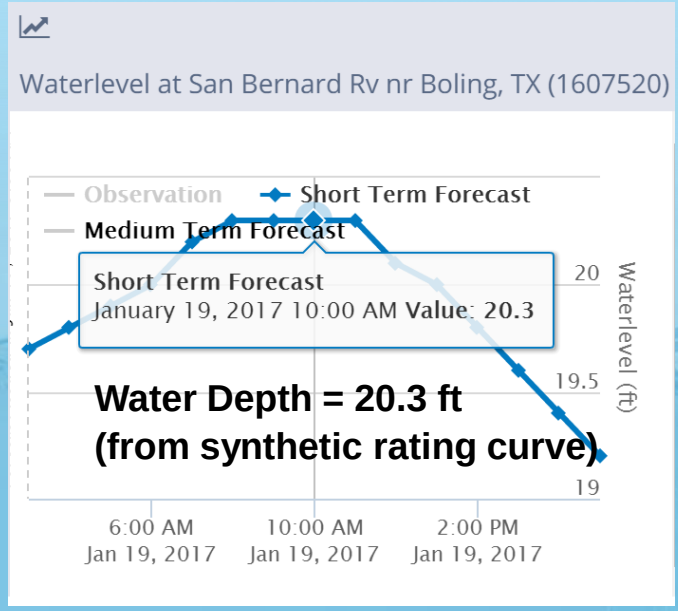
Forecasts are available for each individual stream

TDEM Flood Inundation Mapping System

Forecast of discharge from National Water Model
Converted to depth using a synthetic rating curve

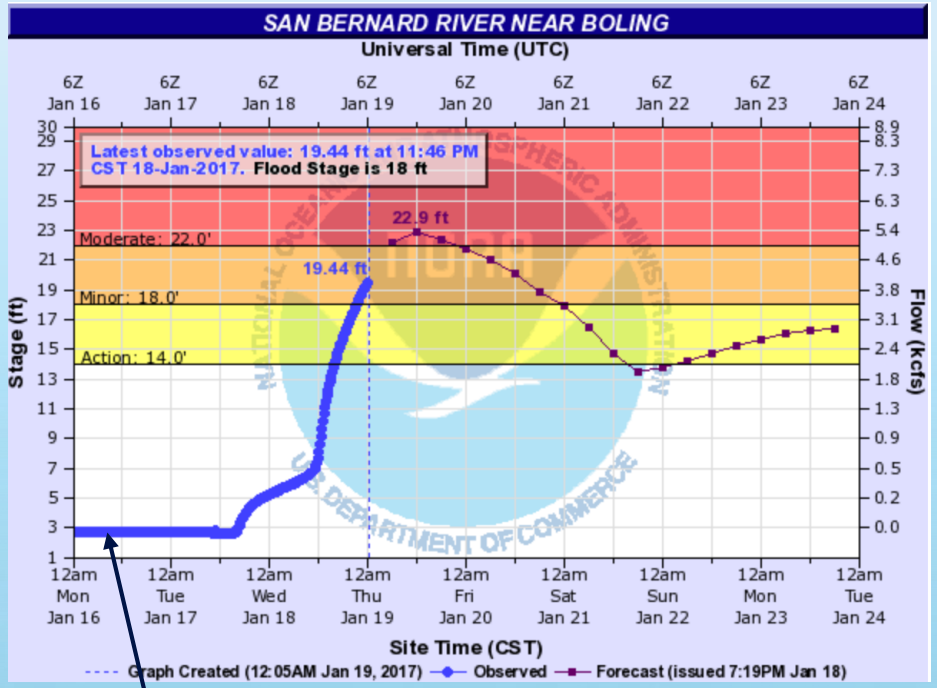


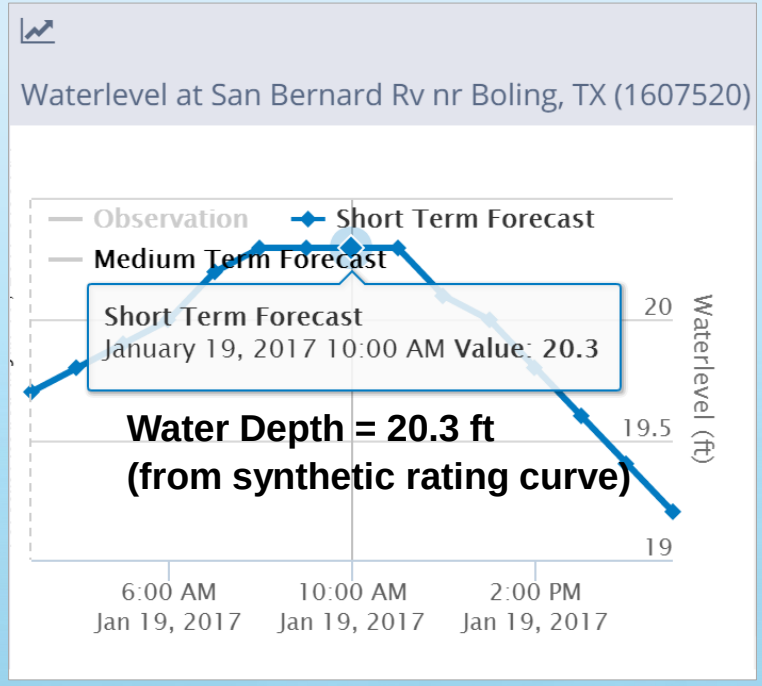




(these data are from the 2AM NWM forecast because of the time lag to do the conversion to depth)

Comparison of WGRFC and NWM/TDEM forecast of Water Depth on San Bernard River near Boling, TX





Stage Height of Forecast = 22.9 ft

Minus Stage Height at Zero Discharge ~ 2.8 ft

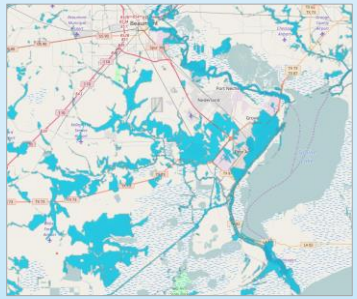
Water Depth in Stream from synthetic rating Curve applied to National Water Model forecast = 20.3 ft

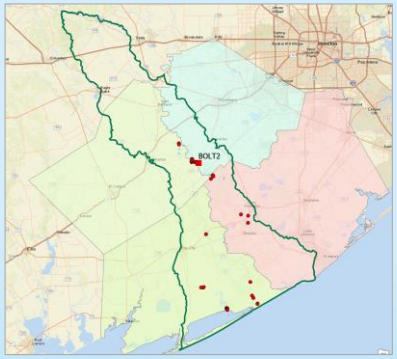
Equals Water Depth in Stream of 20.1 ft from WGRFC Forecast

There is less than 1 foot difference between these two forecast depths!

Flood Response Mapping

- Level 1 – approximate inundation mapping
- Level 2 – approximate impact mapping





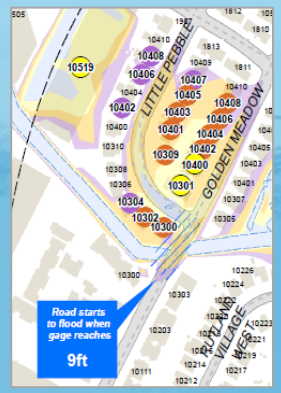
Uses National Elevation Dataset and rating curves

Impact at County scale

- Level 3 – detailed inundation mapping
- Level 4 – detailed impact mapping

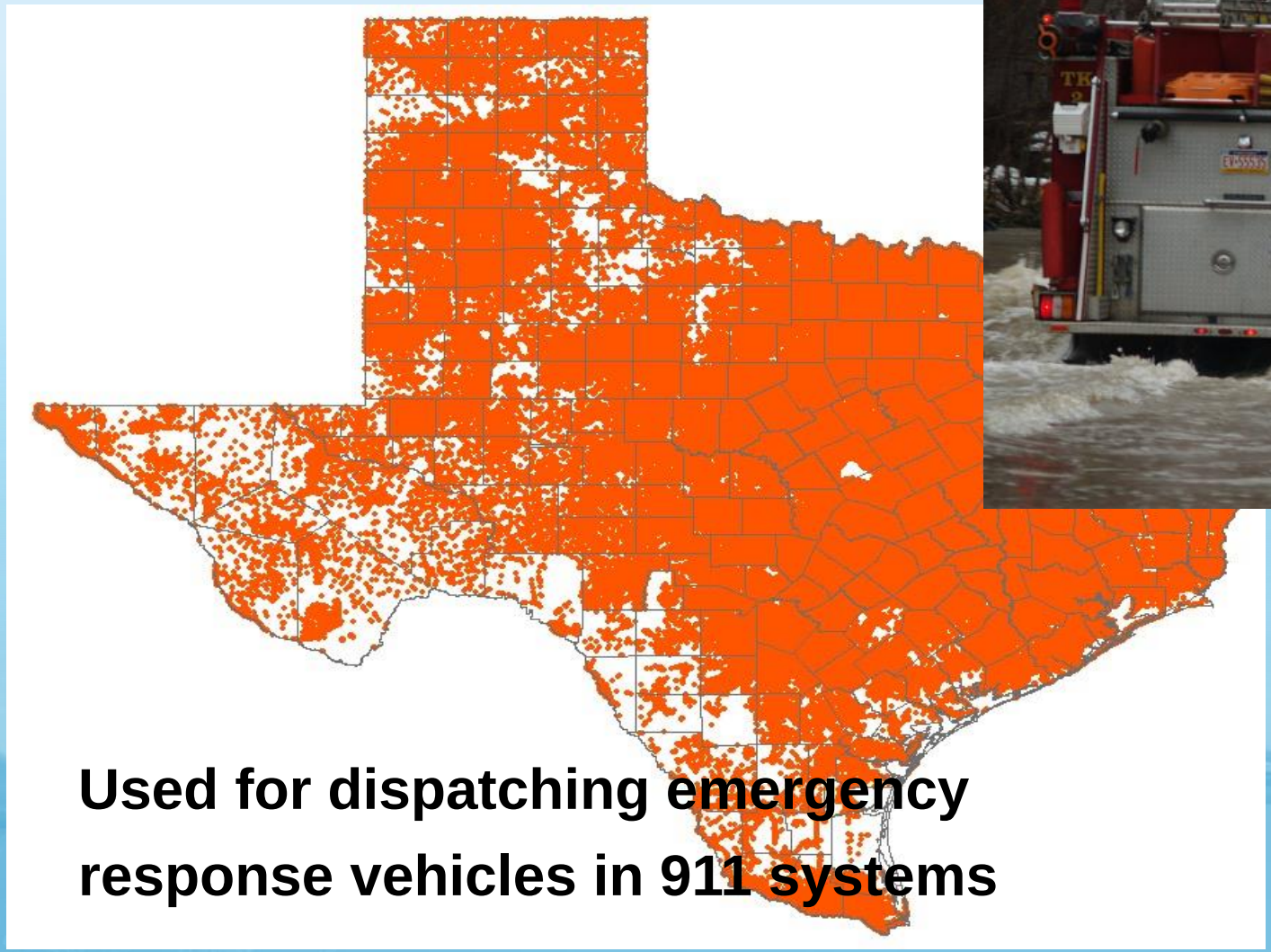
Uses LIDAR and detailed hydraulic modeling

Impact at Stream Reach scale



Texas Address Points

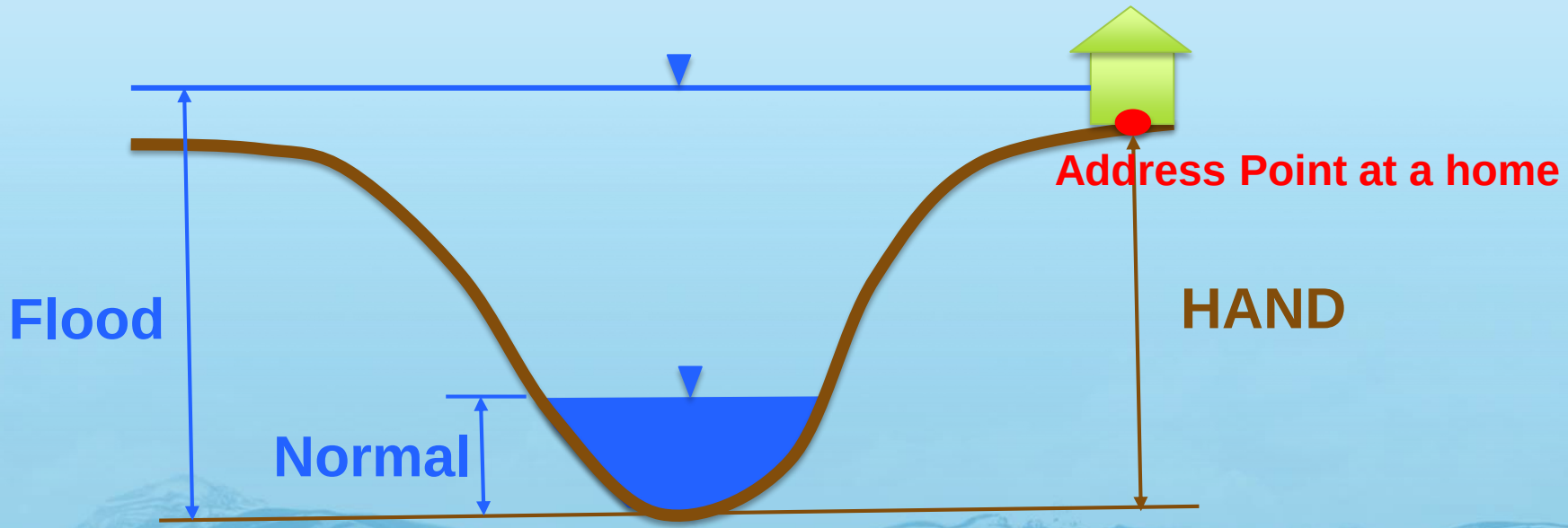
8.6 million points



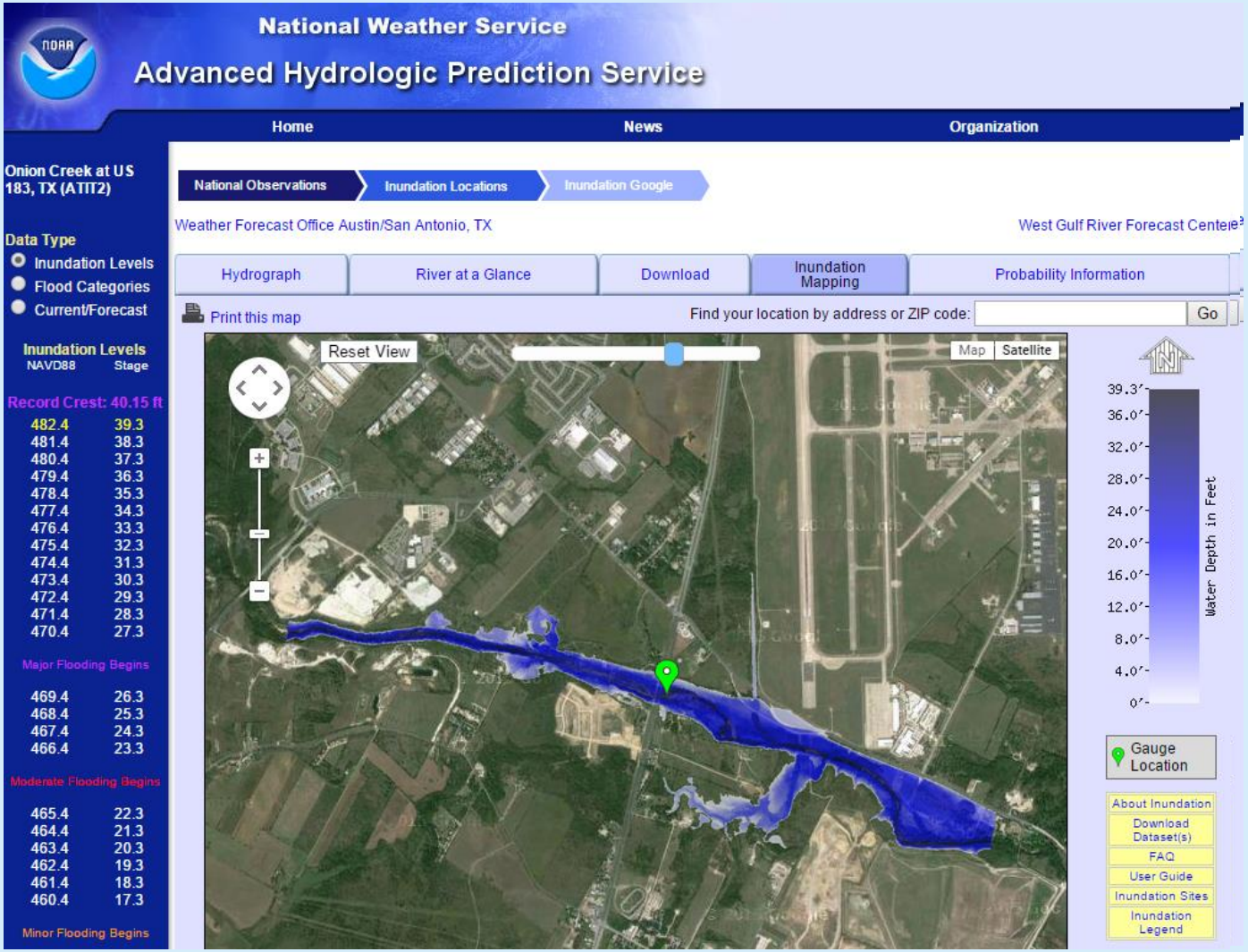
Used for dispatching emergency response vehicles in 911 systems

Method for Determining Flood Risk:
Height Above Nearest Drainage (HAND)

Flooding occurs when Water Depth is greater than HAND



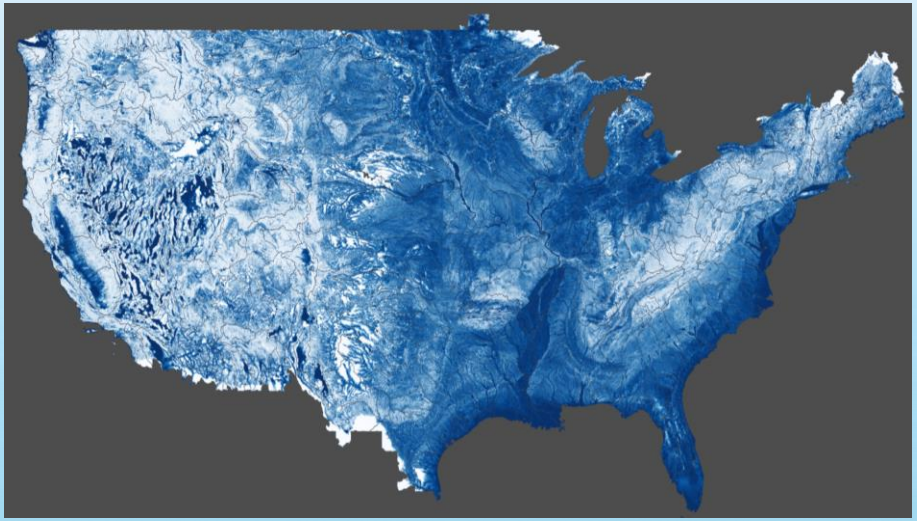
Real-Time Flood Inundation Mapping
Onion Creek at Highway 183



http://water.weather.gov/ahps2/inundation/inundation_google.php?gage=atit2

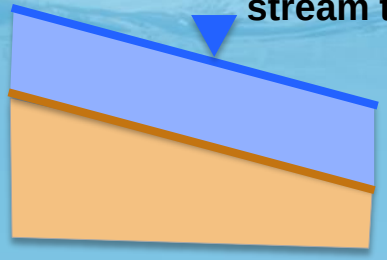
Continental-Scale Flood Inundation Mapping

Catchments and Flowlines

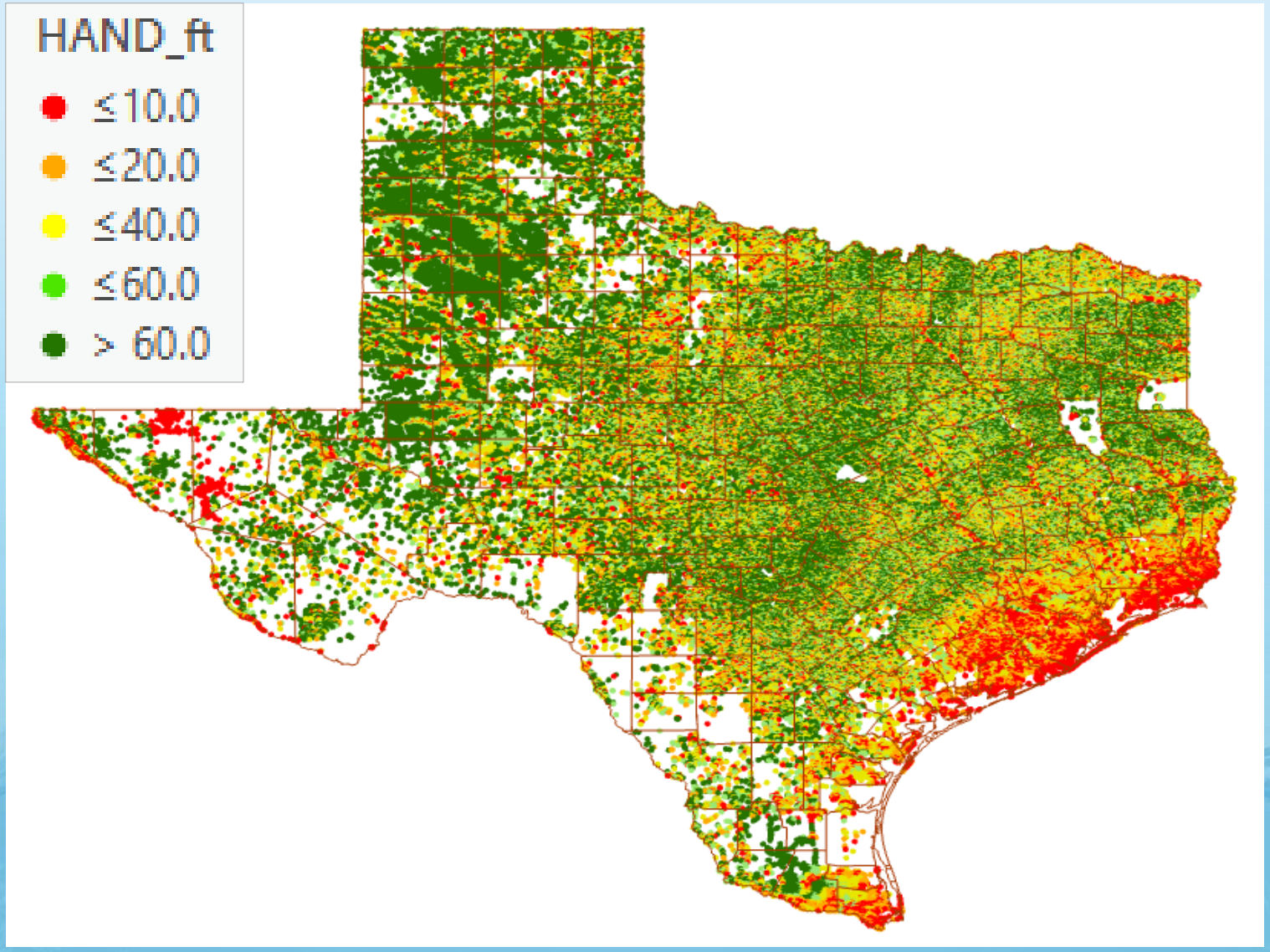


Digital Elevation Model

Height Above Nearest Drainage (HAND)
(relative elevation of land surface cell above cell in stream to which it flows)



Height Above Nearest Drainage for Texas

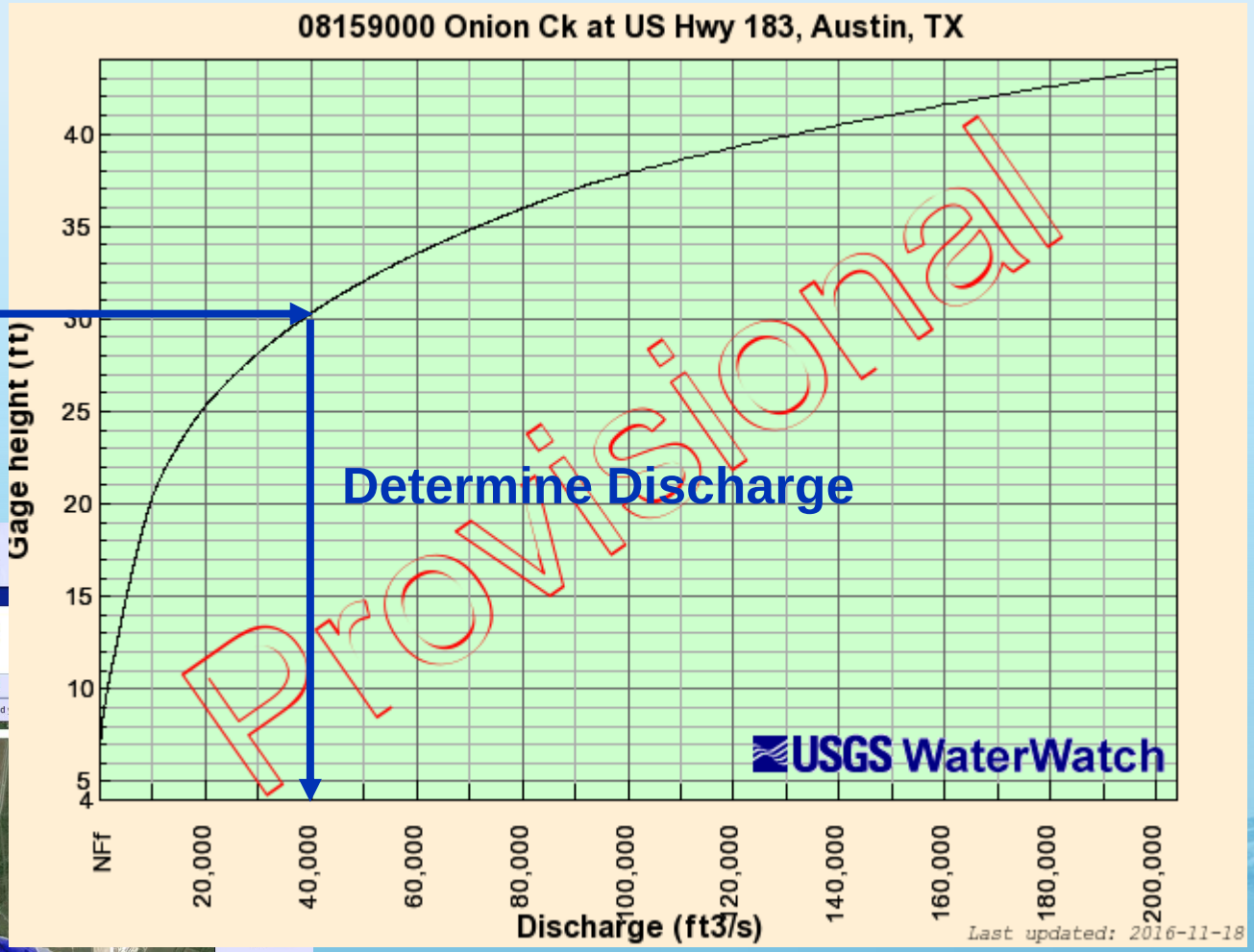


Height Above Nearest Drainage for Address Points in Williamson Creek

This Information Can be Used for Detailed Flood Response Planning by First Responders

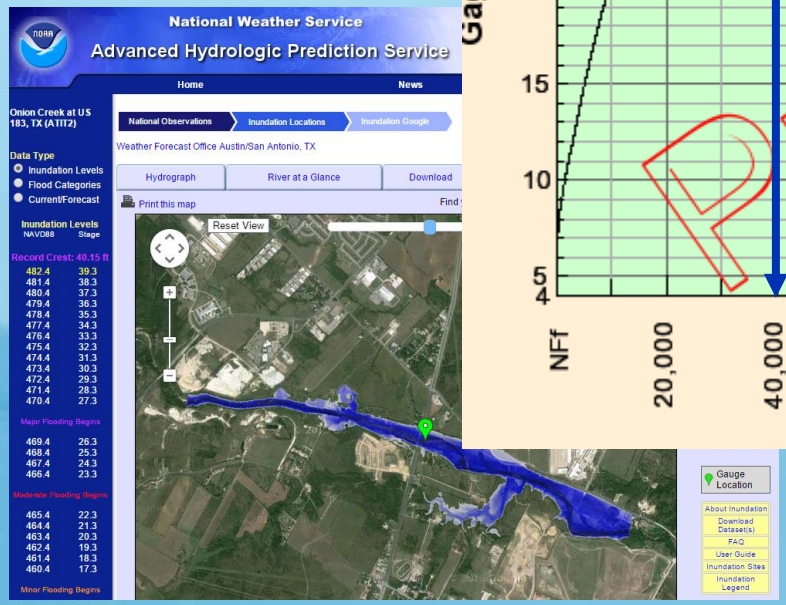
USGS Rating Curve at a Stream Gage

Onion Creek at Highway 183



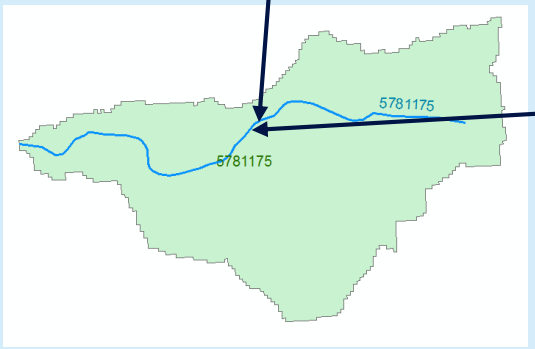
Measure Water Level

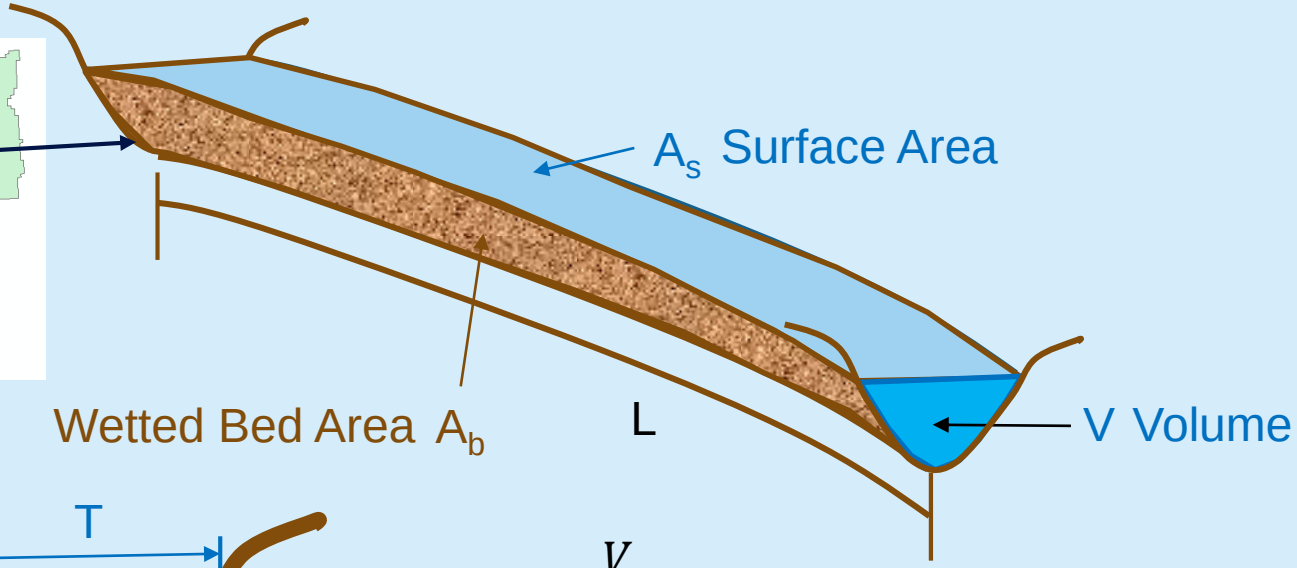
Determine Discharge

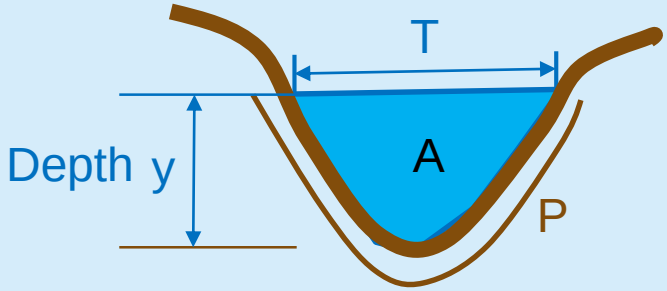


Reach Hydraulic Parameters

Comid	y	A	R	P	T	V	Ab	As
5781175	3							
5781175	4							







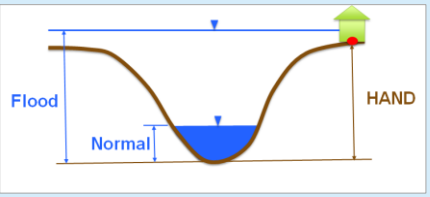
$A = \frac{V}{L}$ Cross Section Area

$P = \frac{A_b}{L}$ Wetted Perimeter

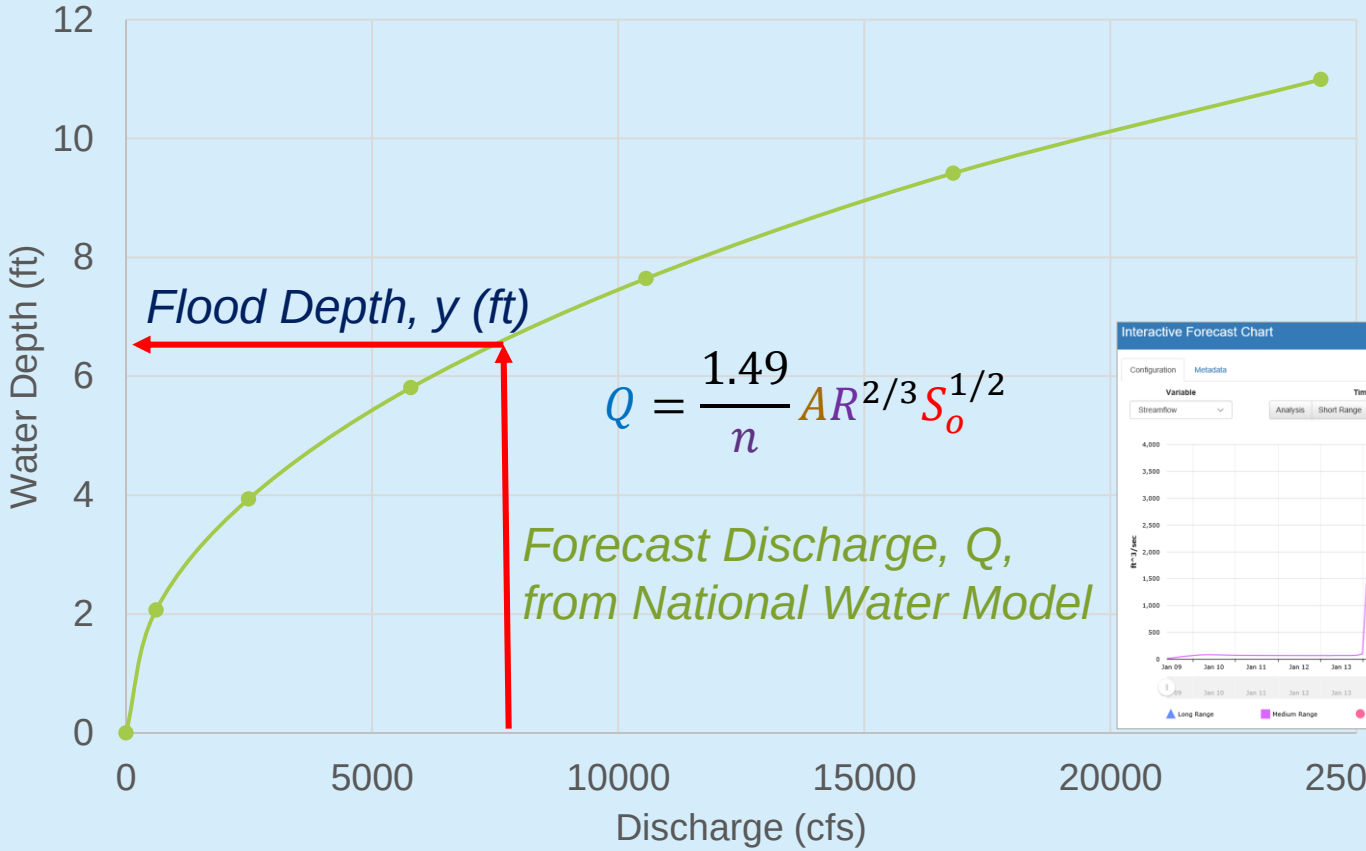
$T = \frac{A_s}{L}$ Top Width

$R = \frac{A}{P}$ Hydraulic Radius

Rating Curve – Connects Discharge with Depth

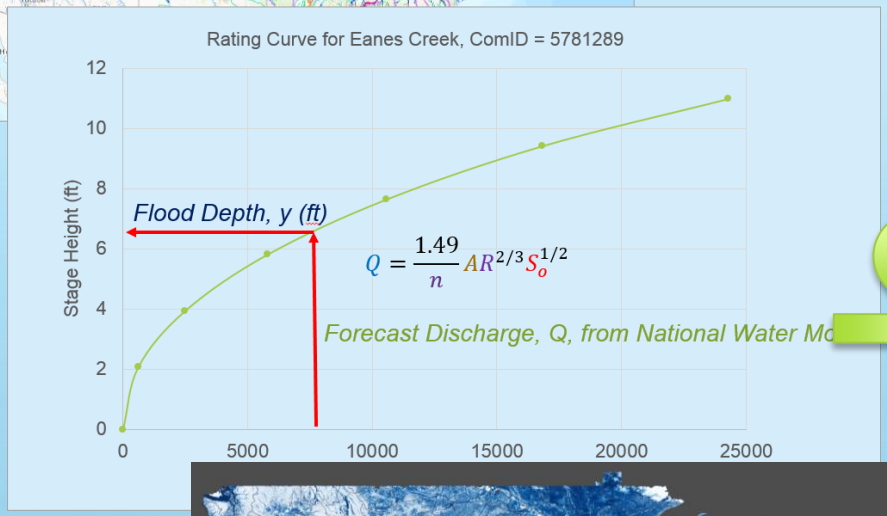


Rating Curve for Eanes Creek, ComID = 5781289

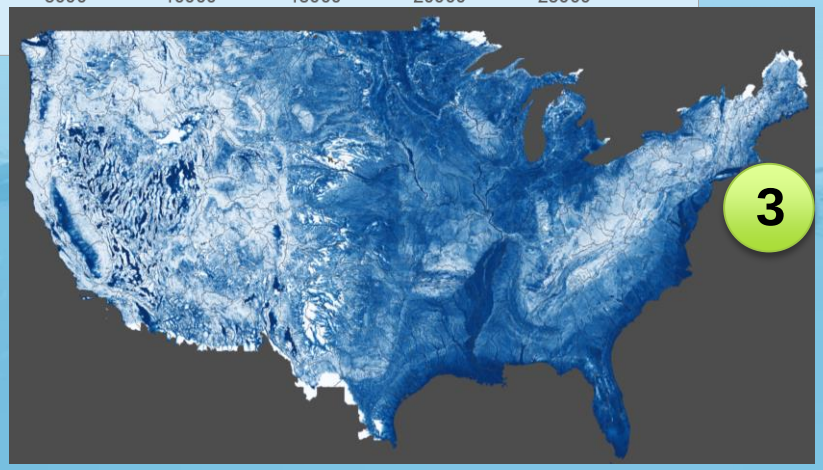


Continental-Scale Flood Inundation Mapping

1



2



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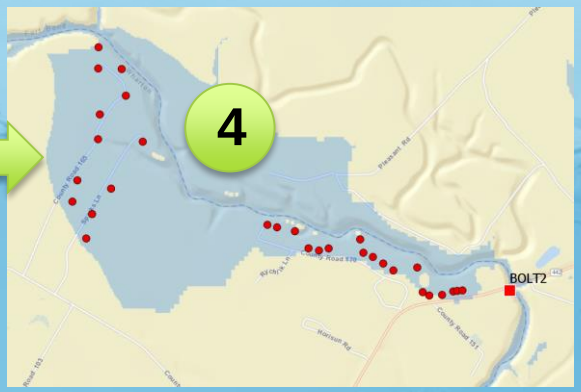


4

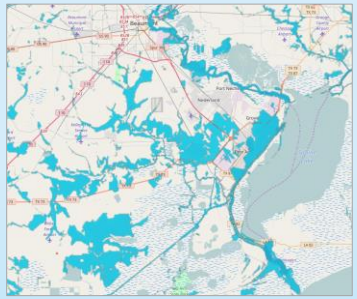
1. Forecast **discharge** with National Water Model

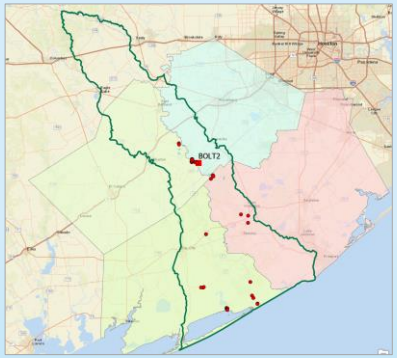
2. Convert discharge to **depth** using rating curve

3. Convert depth to **inundation** using HAND

4. Add Address Points to assess **impact**

Flood Response Mapping





- Level 1 – approximate inundation mapping
- Level 2 – approximate impact mapping

Uses National Elevation Dataset and rating curves

Impact at County scale

- Level 3 – detailed inundation mapping
- Level 4 – detailed impact mapping

Uses LIDAR and detailed hydraulic modeling

Impact at Stream Reach scale